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FOREST TREE PLANTING CAMPS

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The planting of forest trees becomes an established part of forestry practice in every country at some time of its development. Planting began more than a century and a half ago in the United States, but it was not until within the past fifteen years that it has been conducted on an extensive scale, and in accordance with the real fundamental principles of forestry. The recent increase in planting in the United States has been almost phenomenal. More than 30 million trees were planted for forestry purposes during the year 1916. The subjoined tabulation of the number of trees planted upon the State forests of Pennsylvania during the past eighteen years shows the general progressive tendency of the practice.

Year	*Number of Trees*	*Year*	*Number of Trees*
1899	1,000	1908	100,628
1900	1,500	1909	738,461
1901	0,000	1910	1,092,213
1902	5,000	1911	1,663,661
1903	1,600	1912	1,890,404
1904	7,700	1913	3,164,637
1905	40,000	1914	3,393,571
1906	99,550	1915	4,315,436
1907	37,930	1916	5,492,020
Total			22,045,311

The first trees were set out in 1899, and since then a rapidly increasing number has been planted each year, except in 1901. Present indications point to a still further extension of the practice, for over 8 million trees will be available for the planting operations of the spring of 1917. The experience obtained by the foresters, who have conducted the planting operations in the past, will be of inestimable value for subsequent planting.

Among the many important developments, the tree planting camp is probably the most significant, and yet, in many regions, the least known. The data and conclusions presented in this article have been drawn largely from the experience and accounts of foresters in charge of State forests in Pennsylvania and, unless otherwise stated, will refer to these forests.

Eleven planting camps were operated on as many forests during the spring of 1916. Out of a total of 5,492,020 trees set out on all the State-owned land, 2,781,540 were planted by men and boys receiving their board and lodging in camps. The location and general data concerning these camps follow:

State Forest	*Number of Trees Planted*	*Area Planted (acres)*	*Cost of Maintaining Camps*	*Total Cost of Plantations*[1]
Black Forest	559,900	567.9	$510.29	$2,526.87
New Bergen	411,050	379.5	395.16	1,882.32
Ole Bull	381,200	406.7	413.83	1,761.02
Blackwells	355,300	415.1	309.98	1,544.69
Stuart	318,400	189.7	280.75	1,588.65
Caledonia	209,450	120.5	250.50	1,005.49
Hopkins	150,640	99.8	374.35	1,220.04
Nittany	149,200	83.2	45.53[2]	707.32
Sinnemahoning	141,400	57.4	150.60	689.43
Two smaller camps	105,000	67.4	114.56	574.04
Total	2,781,540	2,387.2	$2,845.45	$13,499.87

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[1] Includes cost of plants.

[2] Men supplied food which was prepared in camp.

Planting plans have been prepared for all the State forests of Pennsylvania, which now number fifty-two. A large number of these plans contain recommendations in favor of a still further extension of the practice of planting from camp. This growing tendency prompts the writer to describe their main features and problems, record the most important operating experiences of the past, and discuss their advantages and the questionable tendencies which are developing in connection with them.

Some of the planting sites are located in rather populous regions, while others are situated miles from the nearest human habitation. The labor supply in remote mountainous regions is usually very limited, and foresters in charge of planting operations, as a rule, experience considerable difficulty in recruiting full planting crews. The Black Forest State Forest comprises 30,000 acres, of which area 24,000 acres are barren or covered with a growth of bird cherry, aspen, ferns, and weeds. This entire acreage must be planted. The present supply of labor available for tree planting within a radius of 10 miles could not plant this area in a hundred years. In the midst of the forest is a forest community consisting of one forester, two forest rangers, one game warden, and their families. Towards the east from this settlement by road there is no house for 9 miles, towards the south none for 8 miles, towards the west by trail none for 20 miles, and only one house in 12 miles towards the north. With such extensive areas in need of reforestation and no local labor available to do the work, the erection and maintenance of planting camps becomes obligatory. Laborers must be imported to do the work, and if imported, they must be provided with board and lodging.

The first important problem of a tree planting camp is the selection of a satisfactory site. The essentials of a good camp site are:

1. *It should be centrally located.* A carefully selected camp site may be used a number of successive seasons, if centrally located. Men should not walk more than three miles, and on an average, not over one and a half miles from camp to work. It is wasteful to consume much time and expend a large amount of energy on the road.

2. *It should be rather level and well-drained.* A level camp site simplifies the erection of buildings, tents, and bunks. The drainage is of great importance since planting operations are usually conducted in spring when the ground is full of water. A poorly drained camp site contributes much towards the discomfort of the workmen, whom it is often difficult to retain under the best possible conditions.

3. *It should be near a strong spring or a stream of pure running water.* A large quantity of pure water is needed for drinking, cooking, and laundry purposes. Great care should be exercised that the water supply is not contaminated, especially from stables, toilets, and kitchen refuse. Sanitary regulations are the product of foresight, and are necessary in the conduct of all modern camps. The camp team also needs water and the heeled-in planting stock must be kept moist.

4. *It should be easily accessible from the source of supplies.* The importance of this factor is usually underrated. No planting camp can afford to have many mishaps in getting supplies, whether they be kitchen provisions or planting stock. An entire planting crew may become disorganized because of a single hitch in getting the supplies for the kitchen. A satisfactory conveyance should be available at all times for the transportation of supplies. Telephones are of inestimable value to the managers of planting camps. They simplify the supply problem and afford a ready means of communication concerning forest fires which occur frequently during the spring tree planting season.

Two types of tree planting camps may be recognized, namely, the temporary and the permanent. The temporary usually consists of tents, while the permanent may comprise log, frame, or stone structures. Tent camps have proved to be both practical and economical because planting operations rarely extend over more than six weeks. A camp accommodating 30 to 40 men may comprise the following tents:

(*a*) A single office and store tent, which is the headquarters and sleeping place of the forester in charge. It is the place where the camp business is transacted. A store equipment is indispensable but should be limited to necessaries, such as shirts, trousers, stockings, gloves, tobacco, candy, peanuts, and postage stamps. It prevents the laborers, who are apt to become restless in remote regions—especially on rainy days—from leaving under the pretext of getting tobacco or clothing. A supply of medicine for ordinary ailments, such as headache, colds, sprains, and bruises, should always be kept on hand.

(*b*) One kitchen tent in which the meals are prepared and the provisions stored. The rear part may be used by the cook and cookees for sleeping quarters.

(*c*) One dining tent in which the meals are served on two long board tables running lengthwise.

(*d*) Several bunk tents, the number depending upon their size. A 14 by 22 tent will accommodate 14 men and afford place for a heating stove. The bunks may be made of boards, lined with building paper and then filled with straw. Each workman furnishes his own "kips" or blankets.

(*e*) One lobby tent in which the men may spend their evenings and rainy days. It should be supplied with a stove, a few tables which may be used for playing cards and writing letters, and a number of wooden "deacon" benches. It may also be used for a general assembly place where the forester and visitors can give short informal talks in the evening to the planting crew. A crew will work much better if they are informed concerning the real object and significance of planting. No opportunity should be lost in disseminating information to the men who actually do the work. Tree planting time may be made as popular in the future as bark-peeling was in the past. An evening camp-fire also appeals to many workmen. It creates an atmosphere for story-telling and often stimulates "lumber-jacks" to relate their experiences and describe the forests of former days. Such features prevent the pendulum from swinging too far towards monotony and quietude.

(*f*) A stable for the animals, usually constructed of rough lumber, is also a necessary part of the camp, for a team or an equally reliable conveyance, is an indispensable feature of a well-organized tree planting camp.

The comfort of the workmen should receive first consideration in every camp. Each tent should be provided with a stove and an adequate supply of wood should be handy and ready for use. If stoves are not provided the bunks and blankets become damp and begin to mould in a very short time, and as a result of such uncomfortable conditions the workmen become dissatisfied and frequently leave. Each tent should be carefully inspected before it is occupied and seen to that it will withstand the severe rains and strong winds which occur frequently during the spring planting season. The best tent conditions are none too comfortable in spring time.

Greater comfort is secured in more permanent camps which usually comprise a single or several log, frame, or stone structures, locally called cabins or shacks, and a nearby stable. Some of the State forests already have cabins upon them. On the Blackwell State Forest a frame cabin, consisting of a lobby 16 by 22 feet and a kitchen 8 by 10 feet, was erected at a total cost of $242.80. This amount includes the cost of all materials, labor, grading and clearing. Eighteen men, a number sufficient to form an efficient planting crew, can be accommodated. An additional expenditure of $12.30 provided a spring house and a crude stable for two horses. On the Barree State Forest a log cabin was erected by the forester in charge and his ranger at a cost of $170.08, which included the cost of all material and labor. Such permanent structures have many advantages over tents. They are more comfortable, sanitary and homelike, and consequently prevent dissatisfaction among employes. Furthermore, they offer accommodations not only during the tree planting season, but may be used throughout the year by workmen engaged in road construction, cleaning fire-lines, making surveys, or lumbering operations, and by extra patrolmen during the fire season. Tools, nonperishable food, utensils, and other equipment may also be stored in them.

A sufficient supply of properly selected and well-prepared food is another essential of a tree-planting camp. The average menu resembles that of a modern lumber camp. Sample meals served in tree-planting camps are subjoined:

BREAKFAST

Oatmeal	Ham and eggs or Bacon and eggs	Fried potatoes	Hot biscuits or Bread and butter	Tea and coffee

DINNER

Salted pork	Boiled or roasted potatoes	Two vegetables Dried fruit	Bread and butter	Tea and coffee Pie

SUPPER

Fresh veal	Fried or baked potatoes	Two vegetables	Canned peaches	Hot biscuits or Bread and butter
	Tea and coffee		Cakes or cookies	

The cost of board per man per day during the 1915 and 1916 planting seasons ranged from 48 to 65 cents. One camp served 3,000 meals during the spring of 1916 at an average cost of $0.165 per meal. During the same spring another camp served 2,065 meals at an average cost of $0.215 per meal. An itemized account of the kitchen provisions used by the latter camp and the cost thereof is subjoined:

202	dozen eggs	$44.44
341	pounds veal	40.61
93	pounds butter	27.90
23	bushels potatoes	27.60
108	pounds ham	21.99
1½	cases Karo syrup	3.38
1	case Banner oats	3.25
50	pounds evaporated peaches	3.00
3	bushels parsnips	3.00
263	pounds sugar	21.10
4	cases milk	13.50
2	barrels flour	13.50
74	pounds pork	10.05
69	pounds lard	10.04
31	pounds coffee	5.90
1	case salmon	5.60
1	case roast beef	4.60
1	keg pickles	4.50
27	pounds beef	4.45
1	bushel beans	4.20
½	case corn beef	$3.90
50	pounds dried prunes	3.75
50	pounds cabbage	.65
1	case apples	2.75
1	case pears	2.60
1½	case corn	2.55
1	bag onions	2.50
9	pounds tea	2.40
1	case tomatoes	2.30
1½	case peas	2.25
1	pail mince-meat	2.18
1	box soda crackers	1.56
1	box sugar cookies	1.53
10	pounds bacon	1.10
1	bushel carrots	1.00
½	case beets	.90
Miscellaneous items: spices, soap, mustard, etc.		32.83
Cooks and assistants		92.75
Hauling supplies		10.80
Total		$442.91

The above itemized account is given especially for those who contemplate ordering provisions for a camp, which task beginners usually regard as the most difficult of the entire planting operation. A more condensed or summarized account would have required less space than the preceding tabulation, but it would have had practically no value to the camp organizer, whose most perplexing task is the ordering of subordinate items, which in the aggregate represent a considerable proportion of the total expenditure. Experience shows that care should be exercised in not ordering too large a stock of provisions, for it is, as a rule, easier to replenish the stock than to dispose of surplus. It also pays to buy vegetables, eggs, butter, and fresh meat from local farmers, if possible. The quality is usually better and the prices lower.

A general summary of the tree-planting camp operations on two State forests during the spring planting seasons of 1915 and 1916 follows:

	New Bergen State Forest		*Black Forest State Forest*	
	1915	1916	1915	1916
Number of trees planted..........	429,400	411,050	162,682	559,900
Area planted (acres)..............	418.4	379.5	148.5	567.9
Number of trees per acre..........	1,041	1,083	1,096	987
Wages per hour, including board...	$0.14	$0.15	$0.15	$0.15
Cost of plants....................	1,116.25	635.43	382.11	870.92
Cost of transportation............	30.43	56.13	9.55	79.46
Cost of board.....................	336.16	395.16	148.92	510.29
Cost of labor, including forester and rangers......................	670.90	795.60	314.78	1,066.19
Cost of planting per thousand......	2.49	3.03	2.90	2.96
Cost of planting per acre..........	2.56	3.29	3.19	2.92
Cost of plants per acre............	2.67	1.67	2.57	1.53
Cost of plants and planting per acre.	5.23	4.96	5.76	4.45
Value of land per acre.....	3.00	3.00	3.00	3.00
Total investment per acre.........	8.23	7.96	8.76	7.45

No planting cost is complete without an accurate and complete description of the existing growth upon the planting site. A dense and especially a thorny or vine growth impedes the progress of the planting crew. A thorny or briary growth is destructive to the clothing of the workmen, and makes planting uncomfortable, and, to a degree, hazardous. The density of the existing growth is a vital determining factor of the spacing of the trees, *i. e.*, the number planted per acre, which in turn is a potent influencing factor upon the cost of planting per acre and per thousand.

A wide range of growth conditions is usually present upon such extensive planting sites as those given in the preceding tabulation In order to facilitate description the growth present upon such planting sites can usually be grouped under a few distinctive types. The existing growth upon the 567.9 acres, comprising the area planted upon the Black Forest State Forest during the spring of 1916, may be comprehended from the following description of four sample acres, each representative of a distinctive type of growth:

Acre I.—Comprised 24,792 specimens of trembling aspen (1 to 15 feet high), 264 fire cherry, a few scattered specimens of other hardwoods, and a *sparse* growth of bracken fern, sweet fern, and briars.

Acre II.—Comprised 2,900 specimens of fire cherry and 1,600 trembling aspens mostly from 5 to 15 feet in height, scattered specimens of other hardwoods, and a *moderate* growth of sweet fern, bracken fern, and briars.

Acre III.—Comprised a decidedly scattered growth of bird cherry and aspen, and irregularly distributed groups of chestnut, black locust, red maple, sugar maple, and beech coppice. A *dense* growth of bracken fern, sweet fern, and briars covered the ground.

Acre IV.—Covered by a rather dense, but interrupted, polewood-size growth of very inferior hardwoods, with a very limited sprinkling of white, red, and pitch pine.

The number of trees set out on the above planting site averaged 987 per acre, which indicates an average spacing distance of about 6¾ by 6¾ feet. The presence of such a variable growth necessitates the use of an adjustable spacing distance. Wherever no tree growth was present and the ground vegetation dense, the trees were spaced 4 by 4 to 5 by 5 feet, and upon the areas possessing a scattered growth of trees and a moderately dense ground vegetation the spacing was extended to 6 by 6 or 7 by 7 feet, while on a relatively small acreage with a rather dense tree growth, comprising some valuable species, and a sparse ground cover of vegetation the spacing was still further extended to 8 by 8 or even 10 by 10 feet. The average spacing distance on the 2,387.2 acres planted from camps during the spring of 1916 was a little over 6 by 6 feet.

In spite of the interfering growth present upon practically all the planting sites, the cost of planting was kept down to a commendably low figure, which bespeaks an efficient organization of the entire planting operation of which the camp was a vital part. In the future, forest tree-planting camps will be operated more extensively than in the past, for experience has already proved the following chief advantages:

1. *The planting is accomplished at a lower cost.* Immediately after planting, records are made and filed for each plantation established.

They show the lowest planting costs for planting operations with camps and the highest for small and remote operations which required the workmen to walk long distances to and from work each day. Past experience on the Blackwell State Forest shows that an additional cost of 16 cents per thousand is incurred for every mile walked by the crew in going to and returning from work. The average cost of all the planting operations upon State forests in 1915 was $2.96 per thousand. The cost of planting operations with camps remained below this amount, while operations without camps were usually higher and in five isolated cases exceeded $6 per thousand.

2. *Less time and energy is spent on the road.* This is of considerable economic importance, particularly in case of the Pennsylvania Department of Forestry, which allows its workmen time one way in remote operations.

3. *The planting of remote sites becomes possible.* Areas beyond the reach of local laborers can be reforested on an economical basis. This is often necessary, especially in case of protection forests.

4. *The execution of a rational planting plan is made possible.* Without camps planting is limited to areas near a local labor supply, which may not be the ones in greatest need of immediate reforestation. The establishment of protection forests about the headwaters of streams should take place immediately. Such a procedure requires the establishment of camps on account of the remoteness of the operations. A rational planting plan makes recommendations and outlines procedures which tend toward a normal arrangement or proper distribution of all the stands of a forest—one of the three prerequisites of a normal forest. This important feature of planting plans is, at the present time, often overlooked. It is, however, worthy of careful consideration, because stands are not portable, but obtain their permanent position in a forest at the time of their establishment.

5. *Supervision over the food supply and the resting hours of the workmen is secured.* Many willing native denizens and floating laborers receive an inadequate quantity and a poor quality of food at their homes and boarding places. Under such conditions their best efforts are not productive of satisfactory results. In camps the quantity and quality of food can be adapted to the work, and the resting hours can be so regulated that the energy of the workmen is not dissipated.

6. *Wider publicity concerning tree planting is obtained.* Tree-planting camps will become as popular as the lumber and bark-peeling

camps of the past. They are now receiving wide publicity while the ordinary tree-planting operations go on unheralded. In the spring of 1916 a newspaper man traveled 50 miles to a tree-planting camp in northern Pennsylvania for the purpose of "writing up" the operation.

7. *Places men in the forest during the spring fire season.* A tree-planting crew of 20 to 30 men, near at hand and ready to fight forest fires at any time, is a great protective asset to a forest. The spring fire season is at its height during tree-planting time, and fire-fighting tools are kept on hand at all the planting camps. The telephone connection, maintained between these camps and headquarters and fire-towers, facilitates the prompt calling out of the men at the early stages of fires.

These advantages of forest tree-planting camps, most of which are of vital economical significance, will naturally tend both to enlarge their present scope in regions where they are already established, and extend their use into new fields. While present experience recommends an extension of the practice, it also throws light on a number of tendencies which should be carefully and critically examined with the specific object of determining whether the development and ultimate outcome of the stands resulting from the present plantations will be satisfactory, or if a modification of the present procedure would be productive of better results. The two principal tendencies, which seemingly embody unfavorable features, are:

1. The planting of remote sites before the proper economic time.
2. The establishment of large plantations.

1. *The planting of remote sites before the proper economic time.* A tendency towards reforesting more or less remote areas previous to more accessible sites, has, in some localities, been recently discernible. A number of apparently valid reasons have been advanced in justification of this development. Recent stock surveys show that some of the most inviting and productive areas in need of artificial reforestation are located in remote regions. The high and relatively inaccessible plateaus of the Allegheny mountains comprise vast level areas with a fairly deep and fertile soil, and a sparse covering of woody vegetation. Such existing conditions make planting relatively easy, and consequently lower the cost of the operation. There may also be a compelling desire on the part of the forester to establish plantations in the midst of extensive denuded areas with the hope that in a few years the planted areas will become oases within acres of

desolation, and, due to the strong contrast, serve as impressive object-lessons.

While the above reasons apparently justify the planting of remote sites at the present time, they, however, cover only one phase of a good business, viz: economic production. To market a crop advantageously is just as essential to the welfare of a good business as to produce it economically. Market conditions, distance to market, and transportation facilities may make the profitable disposal of products derived from remote areas difficult, or even impossible, while similar products procured from areas nearer to points of consumption or manufacture may be marketed at a fair profit.

Thinnings, which are necessary for the rational development of any stand, may be deferred beyond the proper silvicultural time, or even omitted, because the yield therefrom would not pay the expense of the operation. The low net income from felling operations—both intermediate and final—is often directly attributable to heavy transportation charges, particularly, in case of remote operations. The Hartigs,[1] in writing concerning the selection of regeneration areas, enumerate ten determining factors which should always be carefully considered, one of which states explicitly that the annual regeneration areas must be so located, and when necessary so distributed, that the wood derived therefrom can be transported as easily and cheaply as possibly. It follows, then, as a rule, that the more remote a plantation the greater are its silvicultural and economical handicaps, and the less refined must be the methods of handling it. The adequate protection, as well as the rational development of remote plantations, is difficult and expensive, which more than counterbalances the ease and cheapness of their establishment. The executive officers and workmen generaly take less interest in plantations far removed from human habitations and traveled highways, than in those situated at points frequented by tourists and pedestrians.

The future economical development of remote forest areas cannot be foretold accurately enough at present to justify any deviation from ordinary procedures. Therefore, it seems logical that the development of a forest property should proceed from the most accessible part towards the more remote, that is, the forest, and that part of each forest which seemingly will be handled most intensively in the future should be reforested first. It should, however, be remembered that departures from the above rule are permissible, and often commendable, especially in case of such special projects as the development of protection forests about the headwaters of streams.

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[1] Hartig, Dr. Theodore und Dr. Robert: Lehrbuch für Förster. Zweiter Band, s. 21. Stuggart, 1877.

2. *The establishment of large plantations.* The size of plantations is a subject which has received very little consideration until recently. Heretofore, the small output of nurseries, and the relatively high cost of planting material, and the limited experience in the technique of planting have acted as natural checks on the establishment of large undivided plantations. All the older plantations are consequently small or average in size. During the past decade, however, many forest tree nurseries have been started and developed at such a phenomenal rate that they are now turning out millions of trees annually. The enormous output of these nurseries and the now relatively low cost of planting stock have stimulated the practice of planting to a degree formerly undreamed of. The present wholesale method of planting, as a rule, accomplishes the task at a cost considerably below that of the retail or parcel method of the past. It, however, embodies the questionable tendency of making large undivided plantations. During the past few years six plantations, ranging in size from 379 to 567.9 acres and averaging 444 acres, have been established in connection with tree-planting camps on State forests in northern Pennsylvania. A number of questions suggest themselves concerning this tendency. Can such large and undivided plantations be protected as adequately against fire, fungi, insects, wind and other destructive agencies as the same number of trees in smaller and scattered plantations? Do such large plantations form satisfactory units of silvicultural treatment and development? Will they fit into a rational plan of management or will they be cumbersome misfits?

The answers to these questions must be based upon empirical knowledge and not upon *a priori* judgments. American experience, however, does not shed much light upon these questions, because practically all the large plantations have been established so recently that the problems of protection, silviculture, and management, which have been met and in many cases successfully solved, contain few, if any, practical suggestions concerning the rational development and ultimate outcome of older stands. European experience in this particular field of inquiry, on the other hand, extends over a long period of time

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and covers a wide range of conditions. German foresters[2] are by no means all of one mind concerning this subject of large versus small area management. The foresters—particularly silviculturists favoring natural seed regeneration—who are primarily concerned with the technical aspect of forestry, namely, the production of the crop, recommend relatively small regeneration areas, while those who are chiefly engaged in the business aspect of the subject, namely, the procuring of the revenue, favor larger regeneration areas. There is, however, general agreement among them that neither the very small nor the exceedingly large regeneration areas are the most desirable and practical.

In answer to the first of the above questions the Hartigs[3] have written that large regeneration areas are more difficult to protect against fungi and insects, suffer more from drought, sun-scald, frost and grassy growth, and result in a greater amount of windfall and windbreak than small regeneration areas. Mayr[4] states that the small-stand method of mixing species serves as a natural check upon the migration of calamities caused by insects, snow, and storm. Toumey[5] recommends that when large continuous tracts are seeded or planted it is often desirable to subdivide the area into 20 to 40 acre divisions separated from each other by suitable fire lines. The avoidance of large areas of young stands (especially important in conifers on account of fire) is advised by Roth,[6] who also states that it is almost certain that the next fifty years will demonstrate the dangers and losses in the United States which are sure to come with extensive unbroken areas of pure growing stands of pine. The foregoing opinions are authoritative, and show beyond a doubt that it is not safe to plant extensive undivided tracts to forest trees, particularly coniferous species. The writer has yet to find a single person who can offer an effective method of combating a forest fire, when well under way, within a pure stand of even-aged white pine or other evergreen conifers, in the thicket stage, *i. e.*, when 10 to 25 years old.

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[2] Endres, Dr. M.: Grossflächenwirtschaft und Kleinflächenwirtschaft. (Forstwissenschaftliches Centralblatt, s. 401–412, August, 1913.) Also Wagner, Prof. C.: Gross-oder Kleinflächenwirtschaft. (Forstwissenschaftliches Centralblatt, s. 3–26, January, 1914.)

[3] Hartig, Theodore und Robert: Lehrbuch für Förster. Zweiter Band, s. 22, Stuggart, 1877.

[4] Mayr, Heinrich: Waldbau auf naturgesetzlicher Grundlage, s. 548. Berlin, 1909.

[5] Toumey, James W.: Seeding and Planting, p. 185. John Wiley & Sons.

[6] Roth, Filibert: Forest Regulation, pp. 122, 126. Ann Arbor, Mich.

At this stage of development such stands are an almost impenetrable thicket, and a veritable fire trap. It is next to impossible for any human organization to stop a fire within a stand under such conditions unless specially favored by natural agencies, such as rain, snow, dampness, and wind. The first reliable vantage points from which the fighting crews may work are the borders of the stands or plantations. Therefore, the less remote these borders are, that is, the smaller the stands, the less will be the acreage burned over and lower the consequent loss. The present status of the fire problem, and the white pine blister rust and weevil situation, should automatically tend to arrest the present tendency of establishing 100 to 500 acre plantations.

There appears to be general unanimity among European and American foresters concerning the second question. Mayr[7] saw in the small stand the only sure means of keeping the pure stand within proper limits of insuring the retention of valuable species, and of making possible the proper and timely conduct of eventual cleanings, thinnings and accretion cuttings. According to his point of view the establishment of species in small plantations was in full accord with the naturalistic fundamentals of silviculture which required that each species must be planted upon the particular site to which it is best suited. This is practically impossible in case of large, pure plantations, except where extensive areal uniformity of habitat exists, which is a very rare occurrence. He also states that the necessity for the small stand increases the warmer the climate, the better the soil, and the greater the number of valuable species inhabiting the region, and recommends that the subcompartment—the stand of today—be subdivided into stands of 1 to 8 acres each, and only in special cases should the aggregate area of stands be increased to 12 acres. Wagner[8] goes a step farther and recommends that each compartment (30-50 acres) should gradually be transformed into an independent cutting series (Hiebszug), comprising a variable number of stands or age gradations. Roth[9] states that good silviculture calls for *small cutting areas,* and furthermore maintains that it is much easier to reproduce a stand of timber, whether by natural or artificial reproduction, if the area to be covered is small and surrounded by forest. It follows, therefore, that in order to develop a forest rationally from a silvicultural point of view it must be made up of a large number of small stands which offer many points of attack for reproduction, reinforcing, cleaning, thinning, and other improvement operations. A forest composed of large continuous stands is not flexible enough for practical and efficient treatment.

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[7] Mayr, Heinrich: Waldbau auf naturgesetzlicher Grundlage, s. 546–551. Berlin, 1909.

[8] Wagner, C.: Der Blendersaumschlag und sein System, s. 258. Tübigen, 1912.

[9] Roth, Filibert: Forest Regulation, p. 122. Ann Arbor, Mich.

The third question does not fall within the scope of forest protection nor silviculture, but within the field of forest organization—a branch of forest management. Forest organization does not only indicate the most desirable size for the units of management and units of treatment, but also specifies a minimum limit below which it is not practical to differentiate stands and a maximum limit above which they are unwieldy. If there was no minimum limit one would ultimately come down to a single tree management which may be feasible in the teak forests of India and in an arboretum, but is not practical in American forests. According to recent German regulations the minimum size to which stands are differentiated varies from one-half acre in Saxony to two and one-half acres in Prussia and Bavaria. One hectare (2.47 acres) appears to be the generally accepted minimum. According to recent instructions issued for the state forests of Austria a minimum size of .6 hectare (1.5 acres) for definite organization and 2 hectares (5 acres) for provisional work is specified. Stand differences of less extent are usually recorded in a written description. No binding prescriptions can be issued, but for practical purposes the minimum size may be taken as 1/50 of 1 per cent of the total area of an average-size forest. Hence, in a forest of 20,000 acres the differentiation may be carried down to about 4 acres, and in a forest of 60,000 acres down to 12 acres. These figures do not indicate absolute limits which must not be crossed, but rather serve as warning signs below which the size of plantations, and the stands resulting therefrom, should not be reduced unless compelled by circumstances or required for experimental purposes, because extremely small stands cost more to establish per unit of area, necessitate an ultra-intensive system of management, require a very intricate road system, make inspection and mapping difficult, and present almost unsurmountable obstacles to the forest organizer working towards a normal arrangement of the stands of a forest. Overlarge stands, on the other hand, are equally undesirable and impractical. The most desirable size of stands for the orderly management of a forest property may be approximated from a consideration of the size of compartments, the generally recognized units of management, which in some cases coincide with stand or else embrace a number of stands. According to Martin[10] compartments should have the following average size: Broadleaf species, 60 acres; pine, 50 acres; spruce, 37 acres.

Only in special cases and under exceptional conditions do European authorities recommend compartments of more than 100 acres. Because of the size interrelation between compartments and regeneration areas in Europe and the less intensive management in America at the present time, 100 acres may be taken as a conservative maximum for the size of plantations and other regeneration areas. Unbroken plantations of coniferous trees of more than 50 to 100 acres should rarely, if ever, be made. The establishment of overlarge plantations (250 to 550 acres) is an unsafe venture. They are unwieldy, and do not fit into a rational plan of continuous or sustained yield management of forests with an average aggregate area of about 20,000 acres. They may be a means of restocking denuded areas rapidly, but they do not assist in bringing order into a forest property.

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[10] Martin, H.: Forsteinriehtung, s. 29. Berlin.